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Science Education in Singapore: Toward "Fitness for Use"

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T h i s p a p e r o p e n s with a discussion of some general characteristics of the Asian educational system and then provides a more complete description of science education in Mainland China and Taiwan. The paper concludes with a discussion of the issues and trends of science education in Mainland China and Taiwan. A b s t r a c t

T H I S P A P E R D I S C U S S E S the changing role of science education in Singapore vis-a-vis the country's economic development. Unhindered by traditions or cultures adverse to the learning and application of science, science education is expected to continue to enjoy the support it has received in the past. Improvements in science education will continue to be linked to the country's economy.

Educational System

Singapore is populated by a mix of several oriental ethnic groups, including Chinese (77 percent), Malay (14 percent), and Indian (7 percent). It was ruled by the British for nearly one and a half centuries-from 1819 until it achieved independence in 1965. To at least some degree science education in Singapore parallels the situations found in other developing countries that were subject to Western rule in the past.

The shifts taking place today in science education have been motivated by the changing needs in Singapore's economic development. Science education can no longer be detached from the evolution and character of society; in many nations, capabilities in science and economic development can be seen to be driven by each other. In Singapore, one sees the two going hand-in-hand with virtually a total absence of conflicts. There is a consensus that critical thinking skills nurtured by science education will always be needed both for the independent learning and advancement of the individual as well as for the survival and progress of the collective. Science, and the professions like engineering and medicine.

The Singapore education system provides a minimum of ten years of formal education for all children. Children between the ages of six and twelve are educated in primary school, where the focus is on three core subjects: English, mathematics, and the mother tongue. Students are educated in secondary school for another four or five years before sitting for the General Certificate of Education "Ordinary" (GCE "O") level examination. Depending on their academic attainments and inclinations, students may then continue their postsecondary education in the technical or commercial institutes, in the polytechnics pursuing diploma (nondegree) courses, or in the "junior colleges" preparing for the "Advanced" (GCE "A") level examination. The examination results determine eligibility for entry to one of the two local universities.

Because English is the language of administration, commerce and industry in Singapore, it is the medium of instruction tllroughout the education system. The GCE examinations are held jointly with Cambridge University, and all polytechnic or university professional programs such as engineering are required to be accredited by the appropriate professional bodies of the United Kingdom.

Science Education

One can readily discern a few broad objectives in science education in Singapore. The first objective involves the training of the mind: building up skills in gathering and assessing facts, developingr a capability in investigating phenomena and problems, and cultivating rational and creative thinking. The second objective is to impart knowledge about tlle physical world, living things, the environment, and the future of humanity. The third objective-a practical one-is to prepare the students for their future occupations.

From an education point of view, these three dimensions of science education should enjoy equal emphasis in curriculum design and teaching formats; the more idealistic rrsight cve.l wallt ro ser pricrlt,es in the sarmc order as the listing. However, there has been more ernpnasis on tne [-nird objective, the practical training of students. In fact, the guiding principie behind science education in Singapore can be traced to a government statement on education policy issued soon after Singapore's independence: "Emphasis is on the study of mathematics, science and technical subjects designed to equip the youth with requisite skills, aptitudes, and attitudes for employment in the industrial sector." Such a policy was sct against the following backdrop: a city republic of about 250 square miles, nearly three million people (by 1994), and no natural resources. The only resource of the country is humans, and science education is seen as an important means of cultivating this resource so that it can be used for economic development at both the individual and societal levels. Science education prepares the young, directly or indirectly, for positions ranging from shop floor technicians to research and development engineers.

New Role of Science

Today, more than thirty years after independence, the economic achievements of Singapore are visible to all (per capita GNP is 824,()()0). The question now is whether the same approach to education should continue for the next thirty years. In 1991, the Singapore National Science and Technology Board was established, with the mission 'to develop Singapore into a center of excellence in selected fields of science and technology so as to enhance national competitiveness in the industrial and service sectors." Among the major programs of the board is manpower development, aiming at bringing about forty research scientists and engineers per ten thousand labor force (relative to about ninety in Japan and eighty in the United States). A second university, the Nanyang Technological University, was formally established in the same year, and awards werc created to promote graduate education and research, particularly in the key areas of information technology, microelectronics, electronic systems, manufacturing technology, materials, energy, water, the environmellt, resources, biotechnology, food, agrotechnology, and medical science.

Attributes of Scientific Manpower

To ensure that the educational system will be able to meet the projected demands for a more scientifically literate workforce, the educational goals in Singapore have recently come under scrutiny. It was generally agreed that in the future science education should be as multidisciplinary as possible, and more emphasis should be placed on skills related to gathering,

screening, prioritizing, and utilizing information in the course of problem solving. It was not felt that a mastery of knowledge per se should be the overriding concern of science education. Rather, emphasis should be placed on innovative and creative thinking, because it was felt that this will prepare students to cope with complex problems in the real world.

It has been noted that with the increasing trend toward globalization in business activities and technology applications, more and more scientists, engineers, and technologists will find themselves working in unfamiliar cultural environments in different parts of the world. An awareness of social, cultural, and religious differences is essential for the application of knowledge to have a worldwide impact. In this respect, courses in history, sociology, or languages should not "stand alone" but be integrated into science and technology courses as far as is practicable. Existing study abroad and exchange programs should be greatly expanded, because longterm benefits are even more likely given that the world has been made smaller by speedier physical and information communications.

Future Orientation

Science education in Singapore has assumed a utilitarian approach out of necessity. A new outlook is now taking shape to prepare the country for the challenges of the next millennium. These challenges are characterized by seven "C"s: changes, complexities, communications, constraints, choices, cross-cultures, and competitions. The responses to these

TABLE 1

Features of Science Education to Meet the Challenges of the Seven "C"s Challenge Changes Complexities Communications Constraints Choices Cross-cultures Competitions Response Broad-based education Multidisciplinary knowledge Information handling skills Creative thinking Systems petspectives Social awareness Teamwork challenges, summarized in Table 1, are appropriate for any sophisticated and outward-looking society.

The great American quality guru Joseph M. Juran has defined quality as "fitness for use." From this perspective, the quality of science education in Singapore is constantly maintained by educationalists making sure that science is fit for use by society.